

bart impact program

THEORETICAL FRAMEWORK FOR THE EVALUATION OF ECONOMIC AND FINANCIAL IMPACTS OF BART

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The BART Impact Program is a comprehensive, policy-oriented study and evaluation of the impacts of the San Francisco Bay Area's new rapid transit system (BART).

The program is being conducted by the Metropolitan Transportation Commission, a nine-county regional agency established by state law in 1970.

The program is financed by the U.S. Department of Transportation, the U.S. Department of Housing and Urban Development, and the California Department of Transportation. Management of the Federally-funded portion of the program is vested in the U.S. Department of Transportation.

The BART Impact Program covers the entire range of potential rapid transit impacts, including impacts on traffic flow, travel behavior, land use and urban development, the environment, the regional economy, social institutions and life styles, and public policy. The incidence of these impacts on population groups, local areas, and economic sectors will be measured and analyzed. The benefits of BART, and their distribution, will be weighed against the negative impacts and costs of the system in an objective evaluation of the contribution that the rapid transit investment makes toward meeting the needs and objectives of this metropolitan area and all of its people.

BART IMPACT PROGRAM

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THEORETICAL FRAMEWORK FOR THE EVALUATION OF ECONOMIC AND FINANCIAL IMPACTS OF BART



JULY 1976
WORKING PAPER

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16. Abstract This Working Paper outlines the theoretical framework for evaluating the economic and fiscal impacts of the construction and operation of the Bay Area Rapid Transit system. Impacts described in the Working Paper include direct construction expenditures, operating expenditures, impacts on the economy because of changes in transportation services, fiscal burden and impacts on the use of bonded debt in the San Francisco Bay Region. The paper describes the theoretical basis of the research and the hypotheses that will be tested.		
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I. INTRODUCTION

The fundamental purpose of the Economics and Finance Project of the BART Impact Program is to contribute to the understanding of what, in fact, has been the impact of BART on the public and private economy of the Bay Area. This project involves research into techniques for measuring economic impact as well as application of these techniques to the question of BART's impacts.

In spite of a great deal of recent research, there does not exist a single generally accepted body of theory and practice for economic impact assessment of investments in transportation systems.¹ Impact assessments constantly are being subjected to legitimate criticism regarding approach, comprehensiveness, and measurement technique. Above all, criticisms relate to the failure to establish a valid theoretical framework for the impact assessment. The BART Impact Program has emphasized the need to relate the impact assessment to available theory regarding the processes that are being evaluated. Each major project and each separate research task in the BART Impact Program is expected to proceed from a clear description of the theoretical assumptions and hypotheses -- whether specific and well-documented, or quite general -- that guide the research. The requirement to specify the underlying theory is accomplished in this Working Note on the theoretical framework, which includes and supplements the theoretical framework established in the documentation of our Study Design. The bibliographic references contained in the Study Design and the reference to other theoretical research have been augmented in this Working Note. The direction of our methodological approach, however, is unchanged.

¹For a summary and critique of theories and approaches to impact assessments; see Charles River Associates, Inc., Measurement of the Effects of Transportation Changes (prepared for the Urban Mass Transportation Administration, U.S. Department of Transportation), Washington, D.C., August, 1972.

II. EXPENDITURE IMPACTS ON THE ECONOMY

One significant goal of this study is to evaluate the impact that expenditures for constructing and operating BART¹ had on the economy of the nine-county Bay Area. This goal can be expressed in terms of several related objectives. The first of these objectives is to assess the impact of BART's construction expenditures (compared to the expenditure impacts of constructing or installing the NBA) on output, employment, and income in the Bay Area. This impact includes not only the direct contribution of BART expenditures to the regional economy but the indirect or multiplier effects of the investment in BART or the NBA.

A second objective is to determine the direct and indirect impacts on Bay Area output, employment, and income which are a function of the permanent payrolls and other operating expenditures of BART and the NBA. In this context, an assessment will be made of the impact that construction employment and permanent employment with BART or the NBA operating agencies had on employment opportunities, particularly for members of minority and low-income households.

A final objective is to test the widely discussed hypothesis that BART, because of its high capital investment and timing, had an inflationary impact on construction wage rates in the Bay Area.

Various applied models of regional growth and development exist which could be used in evaluating the expenditure impacts of BART. In determining the approach to be pursued in this

¹Section III discusses the distinction between the impacts from the act of constructing and operating BART and the impacts that result from the fact that BART exists.

study, a number of alternative models were evaluated and rejected due either to theoretical constraints or to infeasibility, given the time and budget constraints of this project and the availability of data.

A. Neoclassical Equilibrium or "Mechanistic Models"

Neoclassical equilibrium or "mechanistic models" utilize techniques of input-output analysis, econometric simultaneous equations, export base analysis and **Keynesian** income-investment analysis to simulate regional multiplier effects of exogenous changes in prices or product demand. In each case, it is recognized that regional growth is induced by external forces, such as export demand, investment, or changes in wages and prices. Although there are common assumptions in each of the models, each generic model type has limitations which were determinative in eliminating it as a possible approach.

1. All of the models considered are "demand-driven," while most BART service impacts affect factor supplies, such as land,¹ and labor. This feature has implications for the application of the techniques to BART expenditures: many service impacts cannot be translated, readily, into changes in prices or final demand. While Hirsch describes a "resource-base" model which depends on an aggregate Cobb-Douglas production function, this methodology had not been empirically tested and was deemed too crude for transportation impacts.² A technique for developing supply multipliers was formulated by Hoover, who proposed reversing input-output impact analysis procedures and assuming perfectly elastic demand conditions.³ The latter technique could prove

¹Lee and Averous. "Land Use Transportation: Basic Theory," Institute of Urban and Regional Development, University of California at Berkeley, 1971.

²Werner Z. Hirsch. Urban Economic Analysis, McGraw-Hill, 1973.

³Edgar M. Hoover. An Introduction to Regional Economics, New York: Knopf, 1971.

acceptable for analyzing relatively small transportation service impacts on factor supplies.

2. To date, all regional econometric models have been developed on the basis of translating impacts on national variables into their regional components. In other words, they have been recursive in the wrong direction. An input-output model approach to evaluating expenditure impacts on transportation improvements would avoid this problem, since it would reconstruct the impacts based on inputs to the regional economy. Further, data collection, interpretation, and cost considerations are mitigated for utilization of input-output analysis.

Input-output analysis is not without some disadvantages: the assumption of perfectly elastic factor supply limits its application to wage rate changes. However, a wage rate equation similar to that formulated by Glickman in Mississippi or by Hall in Los Angeles could be used to assess construction wage rate impacts.¹

B. Input-Output Analysis of Regional Inter-Industry Economic Flows

The theoretical framework of analysis selected to satisfy the objectives of this study is that of regional inter-industry economic flows as expressed by an input-output model.²

¹Glickman, Adams, Brooking, "On the Specification of a Regional Econometric Model: A Model of Mississippi," Review of Economics and Statistics, Vol. LVII, No. 3, August, 1975; and Owen P. Hall and Joseph Licari, "Building Small Region Econometric Models: Extension of Glickman's Structure to Los Angeles," Journal of Regional Science, Vol. 14, No. 3, December, 1974.

²Input-output analysis is described in such standard works as William H. Miernyk, The Elements of Input-Output Analysis, New York: Random House, 1965. A methodological framework for the use of input-output analysis in analyzing transportation systems is given in Burke Burright, The STAR Methodology for Short-Haul Transportation: Prediction of Economic Impacts from System Construction, The Rand Corporation, December, 1973.

Input-output models will be developed specifically for the E&F Project in order to:

- ensure a model that is specifically relevant to the Bay Area and to the key sectors impacted by BART and the NBA; and
- ensure that results are related to household income in general and income of minority households in particular.

This model will combine survey and non-survey I-O techniques. Beginning with key sector rows and columns, survey data are obtained from relatively simple industry questionnaires and other primary sources. These data are combined with other non-survey data on industry coefficients. The result is a model that is sensitive to the local (rather than the statewide or national) inter-industry structure and that is more precise in key sectors which could be expected to be most affected by BART or the NBA.

This model is to be based on the premise that:

"Although the survey-based regional input-output table is still the most common type of study, secondary data-based tables are becoming more frequent especially in cases where time and cost constraints are severe. A more satisfactory alternative, as yet little tested, would be for an adjusted coefficients table to be reinforced with survey-based rows and columns for key sectors."¹

Two separate input-output tables will be developed. A table for 1967 will be used to estimate construction impacts and a table for 1974 will be used to estimate impacts of operating expenditures.² An apparently unique characteristic of the

¹Harry W. Richardson, Input-Output and Regional Economics, London: Weidenfeld & Nicholson, 1972.

²The assumption of the BIP for measuring BART impacts is that a hypothetical full service system will be operable at an arbitrary point in time. The data for 1974 will be assumed to reflect the economic activity of inter-industry flows for that point in time.

input-output models that will be developed is that two separate household sectors will be included -- one that reflects average inter-industry flows for non-minority households and one that reflects the characteristics of the average minority household. The differing patterns of consumption by minority and non-minority households cause different multiplier effects resulting from changes in final demand induced by BART or the NBA.

Two household rows will illustrate the differences in direct and indirect effects on non-minority and minority households which are a result of BART or the NBA.

The household sectors will be endogenous to the inter-industry transactions portion of the transaction table rather than being treated exogenously, as an element of final demand. This convention permits a direct calculation of the impact on households of changes in inter-industry flows in those industry sectors impacted by BART or the NBA.

The input-output model permits explicit consideration of the economic impacts of tax payments by Bay Area households to service the debt and operating deficits of BART and the NBA. In an input-output model, the household column represents purchases by households in the region. Household consumption is affected by changes in disposable income because of BART's or the NBA's tax burden. The average effect on income will be estimated for the household sector and, insofar as the data permits, differential payments by industrial sectors to the "government" row also will be prepared.¹ The composite or multiplier effects estimated with the input-output model will thus include

¹Estimating the tax payments of certain industrial/commercial sectors (e.g., retail sales) is extremely difficult. It should be anticipated that the estimates of changes in household income because of tax burdens will be more accurate than those of payments by enterprises that do not shift BART's or the NBA's burden either to the consumer or to a previous production stage, e.g., the manufacturer.

consideration both of direct expenditure impacts and of impacts which the tax burden has on the Bay Area economy.

The question of impacts on opportunities for employment (including opportunities to enter the work force and opportunities to advance in salary, skill level, and job satisfaction) will be investigated by means of employment surveys. These surveys will include the BARTD personnel files (and, insofar as possible, the files of those involved in BART's construction) as well as the personnel files of bus transit agencies in the Bay Area (as a surrogate for employment profiles for the NBA which features bus transit). Wherever circumstances permit, individual employment histories (e.g., prior salary and responsibility levels) will be evaluated. Conclusions about changes in job opportunities will distinguish between minority and non-minority employees.

The basic inter-industry input-output theory that underlies much of this analysis does not deal with changes in prices or wages over time. The impact of BART on construction industry wages will be examined by means of a separate research effort based on a modification of the Phillips curve theory of wage determination.¹ An initial comparison of construction wages by craft in the Bay Area and other regions will be used to detect any regional wage differential or any difference in rates of change. If a discernable difference is detected, a single-equation regression model will be used to infer relationships between rate of change of construction wage rates and regional unemployment rates, as well as other variables such as the consumer price index, annual total capital expenditures, etc.

The hypotheses that are to be tested in this task are summarized in Table II-1.

¹ See R.A. Gordon, The Goal of Full Employment, New York: John Wiley & Sons, 1967. This analysis was related to the BART impact problem in B.F. Roberts, Economic Models for the BART Impact Study (prepared for the Metropolitan Transportation Commission), December, 1974, page 19.

TABLE II-1

HYPOTHESES REGARDING EXPENDITURE IMPACTS ON THE ECONOMY

IMPACTS	HYPOTHESIS	METHODOLOGY	TASK	COMMENTS
Construction Expenditures	1 As a large public investment project, BART capital expenditures had a positive net impact (over the NBA) on <u>regional</u> employment and incomes.	Estimate BART and the NBA direct and indirect impacts on sales, incomes and employment using the appropriate sector multipliers from the 1967 regional input-output model.	3.1 3.2 3.5	This element utilizes hypothetical NBA capital expenditures to obtain a net economic impact. Distributional effects of these regional impacts will also be estimated using the minority and non-minority household sectors of the I-O model.
	2 BART offered significantly more opportunities for employment in the construction industries than did the NBA.	Review of personnel files of the Joint Venture Engineers and other participants. Estimate of employment multiplier effects using the I-O model.	3.2	Separate direct and indirect employment estimates will be prepared for each NBA.
	3 BART construction expenditures did <u>not</u> contribute to a significant increase in Bay Area building trades wage rates.	Comparison of Bay Area wage rate trends to other control regions. Estimate of total construction output and employment for peak years. Regression analysis of variables. Key informant (union leaders, project managers) interviews to assess performance of building trades labor markets.	3.4	
Operating Expenditures	1 BART operations make an approximately equal contribution (compared to the NBA) to Bay Area personnel income and opportunity.	Estimate BART and NBA operations impact on sales, incomes and employment in the Bay Area using the appropriate sector multipliers from the 1974 I-O model.	3.1 3.2 3.6	
	2 BART and the NBA which emphasizes bus transit have equivalent impact on total and minority employment opportunity.	Compare directly employment profile of BART and NBA operations including probable employee background and ethnic origin for the NBA.	3.3	This comparative impact analysis requires a hypothetical NBA employment profile including an assumed affirmative action program.

C. Annotated Bibliography

Boyce, David E. and W. Bruce Allen. "Transportation Research: Problems and Prospects." PPRSA, Vol. 32, 1974, pp. 21-53.

Burright, Burke. "The STAR Methodology for Short-Haul Transportation Impact Assessment: Prediction of Economics from System Construction." Working Note, Vol. VI, Department of Transportation by the Rand Corporation, WN-8050-DOT, June, 1973.

Capozza, Dennis R. "Measuring the Benefits of Urban Improvements." Annals of Regional Science, Vol. IX, No. 2, July, 1975.

Discusses "secondary or reorganization benefits" of urban improvements.

Charles River Associates. Measurement of the Effects of Transportation Changes. Prepared for the Urban Mass Transportation Administration. Cambridge, Massachusetts, 1972.

Consad Research Corporation. A Study of the Effects of Public Investment. Prepared for EDA, U.S. Department of Commerce, 1969.

Methodology for public investment analysis aimed at depressed regions but contains a good review of regional economic theories and models.

EBASCO Services. "San Francisco Bay Area Rapid Transit District." Rapid Transit System Economic Review, June, 1961.

Glickman, Adams, Brooking. "On the Specification of a Regional Econometric Model: A Model of Mississippi." Review of Economics and Statistics, Vol. LVII, No. 3, August, 1975.

Mississippi econometric model might provide a usable construction wage equation which includes construction output as an independent variable.

Hall, Owen P. and Joseph Licari. "Building Small Region Econometric Models: Extension of Glickman's Structure to Los Angeles." Journal of Regional Science, Vol. 14, No. 3, December, 1974.

Los Angeles econometric model driven by national variables and using basic Phillips curve wage relationship.

Lee and Averous. "Land Use and Transportation: Basic Theory." Institute of Urban and Regional Development, University of California at Berkeley, 1973.

Lee, Douglas B. "Analysis of BART Impacts on Bay Area Land Use." Transportation Engineering Journal, Institute of Urban and Regional Development, May, 1972.

Peat, Marwick, Mitchell & Co. "A Review of Some Anticipated and Observed Impacts of the Bay Area Rapid Transit System." MTC, May, 1974.

Anticipated impacts of BART.

Resource Management Corporation, Theory and Implementation of Cost and Benefit Analysis of Transportation Systems: The Northeast Corridor Transportation Project, Maryland, 1969.

Richter, Charles, "Some Limitations of Regional Econometric Models." ARS, Vol. VI, No. 1, June, 1972.

A good review of the structural weaknesses of existing regional econometric models.

Roberts, B.F. California Economic Forecasting Project, Bay Area Research Program -- Technical Report. University of California at Berkeley: Institute of Business and Economic Research, March, 1974.

Sheldon, Nancy and Robert Brandwein. The Economic and Social Impact of Investment in Public Transit, Massachusetts: D.C. Heath, Lexington Books, 1973.

Stanford Research Institute. Benefit/Cost Analysis of the Five Corridor Rapid Transit System for Los Angeles. 1968.

Los Angeles rapid transit cost/benefit analysis predicts increase in population holding capacity and drop in unemployment from rapid transit development.

United States Department of Commerce, "Industry Effects of Government Expenditures: An Input-Output Analysis." Survey of Current Business, Vol. 55, No. 5, Washington, D.C.: U.S. Government Printing Office, May, 1975.

III. IMPACTS OF THE TRANSPORTATION SERVICE ON EMPLOYMENT AND COMMERCE

The study of the economic and financial impacts of BART considers two largely separable aspects of the "economic" (as compared to "financial") impacts of BART -- i.e., the impacts that relate directly to income, employment, value added, etc. The previous section addressed the direct and indirect expenditure effects resulting from the acts of constructing and operating BART or the NBA. The topic of this section, in effect takes the construction and operation of BART (or its alternative) as a given and is concerned with the economic effects of the transportation service offered by BART or the NBA. In theory, the two tasks may overlap. For example, multiplier effects associated with BART's operations contribute to effects that may change the competitive position of the Bay Area. In practice, however, any overlap is inconsequential.

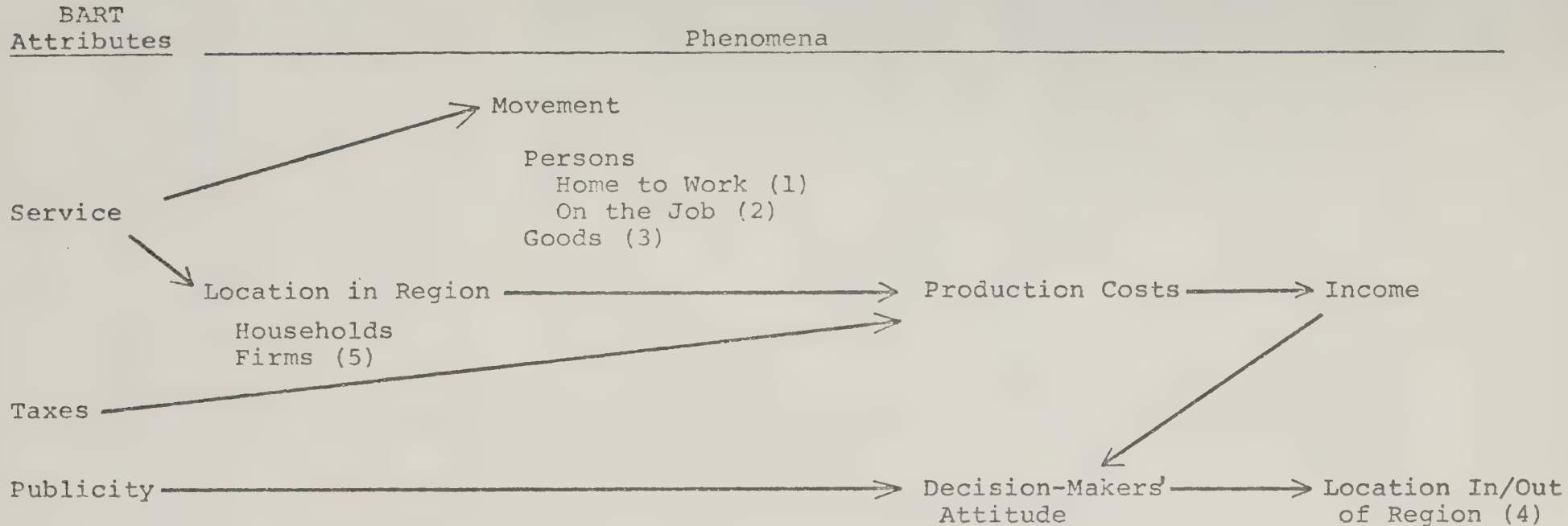
The purpose of evaluating the impacts of transportation service on employment and commerce is to test whether any BART impacts on employment, output levels and resource requirements (i.e., changes in operating efficiency) for Bay Area businesses can be detected.

A framework for the analysis of BART's impact on employment and commerce is shown in Figure III-1. This figure summarizes the direct causal mechanisms that may produce an impact. The figure also summarizes the three sub-classifications of impacts on employment and commerce (i.e., location, efficiency and accessibility).

The three general causal mechanisms in Figure III-1 are each assessed in the technical approach described below. The first and most obvious relates to differential impacts from transportation

FIGURE III-1

SUMMARY OF IMPACTS ON EMPLOYMENT & COMMERCE



Researchable Questions:

- (1) Does BART increase labor force available to employers, and jobs available to workers? How does this affect production costs of firms and income of workers?
- (2) Does BART facilitate business travel? How does this affect production costs of firms?
- (3) Does BART-induced decline in congestion facilitate trucking? How does this affect production costs of firms?
- (4) Do BART's foregoing effects, or publicity about BART, affect image of Bay Area held by persons making decisions on location in or out of Bay Area? How does this affect location?
- (5) Does BART-induced agglomeration facilitate conduct of business?

cost or level of service. The movement of goods is distinguished from the movement of people because the NBA might produce a cost differential for commodity flows from outside the region to the San Francisco peninsula. Similarly, lessened street and highway congestion might facilitate the movement of goods by truck, under the BART scenario.

The second group of causal mechanisms shown in Figure III-1 deals with the economic effects of possible spatial impacts. Put slightly differently, the mechanisms deal with the effects on commerce and industry because of differential patterns of land use in the Bay Area. The basic distinction is that estimating spatial impacts (e.g., increased densities in the central city and possible increased land values because of increased densities or increased business agglomeration) are not directly the subject of this Economics and Finance Project. Insofar as such spatial effects may be identified, however, they may affect the cost of operation of Bay Area businesses.¹ These latter impacts plus such possibly unpriced impacts as improved access to employment are within the scope of this study. Nonetheless, certain impacts on the efficiency of Bay Area business will be analyzed in addition to any direct effects related to the transportation service, per se.

The final causal mechanism summarized in Figure III-1 relates to the composite perceptions and preferences of decision-makers and the effect that BART (compared to the NBA) may have had on such perceptions. Put more bluntly, this causal mechanism deals with the "image" of the Bay Area. The question of "image"

¹As discussed subsequently, certain effects (e.g., clustering of headquarters operations in the central cities) may be assumed by the BIP to be BART impacts so that they can be studied during the E & F Project. Conclusions from E & F can be deleted from the final BIP synthesis if (e.g.) the LU/UD Project does not confirm clustering as a BART impact.

is largely but not entirely intangible, but experience with after-the-fact case studies of locational decisions as well as observations of decision-makers' behavior when the conclusions of plant locations studies are being evaluated confirm that a failure to grapple with the question of "image" is an invitation to overlook a significant element of locational decisions. (In that regard, practical experience in site evaluations and plant location studies confirms that "image" also plays a role in capital investment decisions which, in turn, may affect the Bay Area's labor productivity or overall operating efficiency.)

It should be noted that each of the causal mechanisms (with a possible exception of the effect of decision-makers' attitudes) may influence all three of the impact areas (i.e., location, efficiency of continued operations, and accessibility).

The difficulty of the task of detecting transportation-related impacts on employment and commerce has been noted uniformly. This section reviews the theoretical considerations in the selection of our methodology.

A. Economic Effects of a Transportation System

The economic effects of the existence of transportation systems are, in part, the subject of classic location theory. Unfortunately, as noted recently in a comparable context, where the subject was the use of location theory to prepare forecasts of industrial location:

"Location theory analyzes the location of firms by studying the comparative costs of different firms. Thus, location theory attempts to answer the following type of question: Given several sources of raw materials and several markets, where will a firm locate? The

analysis can be complicated by varying the processing and transfer costs at various locations. A summary of the literature on location theory would be out of place in this study because location theory not only has little empirical content, but offers very unsurprising theoretical conclusions such as, 'long-run competitive equilibrium in a space economy is the same as in a non-space economy; that is, firms will produce where marginal cost equals marginal revenue and average cost equals price.' Location theory tends to be abstract and usually concerns itself with ideal worlds in which only a few variables are important in location decisions, whereas we must analyze industrial growth in the real world with all of its complications. Furthermore, even if location analysis did offer a rigorous and complete analysis of industrial growth, it would be useless for our project since it requires information which is simply not available. To apply location theory, at a minimum one would need a complete matrix of transport costs to and from every county for every different product, a matrix of processing costs at each county for every product, and a knowledge of the demand function for every product in every county. Location theory may thus be applicable if one intended to study intensively one small industry producing a well-defined product with known processing and transportation costs, but application of the theory on a universal basis is hopeless at present."¹

The E&F Project is concerned with changes in costs and other factors within a single region, rather than the cost of movement between regions. Nonetheless, the general conclusion quoted above is equally true but, as discussed below, so is the qualifying final sentence in the quotation regarding the desirability of concentrating on specific industries and specific cases. In fact, the literature tends to present location and spatial decision theory in the abstract, but provides meaningful empirical evidence only in terms of specific and

¹Burrows, James C., Charles E. Metcalf, and John B. Kaler, Industrial Location in the United States, E. C. Heath & Company, 1971, p. 6.

often narrowly-defined industrial activities.¹ Further, the specific research that has been published emphasizes production and distribution rather than the "office oriented" activities that can be conjectured to be most significantly impacted by urban mass transit systems.

Despite this discouraging prognosis, existing theories of regional growth and existing models of the Bay Area economy were reviewed in order to derive a coherent theoretical framework for evaluating transit service impacts. In adopting a methodology, several alternative theories of regional growth and their concomitant empirical models were evaluated.

Two distinct perspectives emerge from a review of regional growth theory and models. The first approach to regional growth is based on neo-classical general equilibrium assumptions. The primary advantage of equilibrium-frameworks is their amenability to quantitative analysis and empirical application. Models within this category include regional econometric and input-output models which are characteristically mini-versions of their national counterparts.

The primary disadvantage of equilibrium models is that they omit the spatial variables that transit services might affect. The neo-classical region is a homogenous plane without locational frictions. In addition, most applied equilibrium models are demand driven (often by national aggregates), whereas transit services affect the supply of labor and access to

¹ A discussion of this situation is provided by Harry W. Richardson, Regional Economics: Location Theory Urban Structure and Urban Change, Praeger, New York, 1969, pp. 342-347.

land. A regional resource-base framework, based on aggregate neo-classical production functions (usually Cobb-Douglas) could be used to analyze impacts on productivity and labor supplies, but this particular model has never been implemented regionally.¹

For the Bay Area, both the econometric formulation evaluated previously by MTC² and the E&F Project's input-output model suffer from the above limitations with regard to measurement of transit service impacts. In summary, the assumptions upon which available equilibrium models are based, preclude tests of hypotheses regarding changes in spatial variables, externalities (cluster economies) or specific impacts on factor productivity.

A second perspective on regional economic development, which emphasizes internal or "cumulative growth" processes, has led to what William Alonso calls polarized space models. The major advantage of polarized space models is that they analyze the contribution of locational (accessibility to markets, resources and labor) and structural (cluster economies, industrial mix, city size, public infrastructure) factors to a region's growth. In other words, cumulative growth theories emphasize the spatial and supply factors which BART services might hypothetically affect.

¹Hirsch, Werner Z., Urban Economic Analysis, McGraw-Hill, 1973, pp. 223-231, 259-263.

²Roberts, B.F., "Economic Models for the BART Impact Study," (prepared for the Metropolitan Transportation Commission), Dec., 1974.

The major disadvantage of polarized space theories is that the interactions and relationships they posit are very difficult to model, much less test empirically. As a result, very few applied models of this type have been developed and none exist for the San Francisco Bay Area.

One of the few empirical polarized space frameworks which has potential for analyzing transit service impacts is the agglomeration or income potential model. These formulations attempt to quantify or weight the influence of the matrix of locational factors which make a certain site economically productive (its "income potential"). Utilizing gravity equations for spatial frictions and land values as a proxy for income potential, these models attempt to demonstrate cluster economies in CBDs, advantages of proximity to labor pools and markets, effects of transportation improvements, etc. Richardson¹ presents a general formulation based on observations from many centers (SMSAs) while Sakagami, et al.,² have used an economic potential formulation to estimate the benefits of improved transportation on the Tokyo economy. Other comparative studies have shown that agglomeration or cluster economies do exist in urban centers, especially for manufacturing industries. These studies are reflected in our bibliography. This analytic direction, however, raises several problems in evaluating economic and financial impacts of BART service.

¹ Harry W. Richardson, "Agglomeration Potential: A Generalization of the Income Potential Concept," Journal of Regional Science, Volume 14, No. 3, December 1974, pp. 325-337.

² Koyu Sakagami, Nobuyoshi Kobayashi, and Ryoichi Kinoshita, "Economic Potential and Its Application for a Regional Growth Model with the Investment Plan of Transportation Facilities," Annals of Regional Science, Volume III, No. 2, December 1969, pp. 1-14.

(1) What could these models tell us about BART's contribution to agglomeration economies? A comparative study could determine that rapid transit is a significant factor in determining income potential, but how much does it contribute relative to other variables? Does BART cause the CBD to grow or does it affect the labor supply of certain industries directly? These aggregate comparative models could not answer this type of question.

(2) Variables would be very difficult to measure for the wide range of factors and flows which affect agglomeration potential, especially considering the type of economic activities BART serves (central offices, particularly finance, insurance, real estate, etc.). The only variable Richardson formulated as a proxy for income potential was per capita land values; yet the E&F Project must assume no change in land values caused by BART, pending conclusions from the LU/UD Project.

Although these limitations led to rejection of a methodology which measured the income potential of a particular location, a closely related approach was adopted which evaluates transit impacts on the income potential of specific industries. The methodology outlined below is based on the premise that the growth potential of certain industries depends on their access to factors of production (i.e., skilled labor), markets (i.e., retail shoppers) and related industries or services (cluster economies). This input-output access theory of

regional growth differentials was first applied in the massive empirical U.S. regional development study done by Perloff, Dunn, Lampard and Muth.¹ Briefly, their approach was to tabulate shifts in economic activity among regions by industry sector (using shift/share analysis which is described subsequently) and then to evaluate the regional factors which contributed to the growth or decline of that particular industry. The advantages and limits of this combination case study-shift/share approach is also discussed in Perloff and Wingo² and Hoover.³

Lichtenberg's classic case study of urban locational advantages and agglomeration economies⁴ also used a sequential research strategy of the type described subsequently.

Before this strategy is described, mention should be made of a possible BART impact -- the impact on labor productivity in the region -- that was considered but then largely excluded from the E&F Project.

BART impacts on productivity, if any, appear most likely to involve the finance and service sectors. A preliminary

¹Perloff, Harvey S., Eric S. Dunn, Eric E. Lampard and Richard F. Muth, Regions Resources and Economic Growth, Baltimore, Md., John Hopkins Press, 1960.

²Perloff, Harvey S. and Lowdon Wingo, Issues in Urban Economics, New York, Knopf, 1971.

³Hoover, Edgar M., An Introduction to Regional Economics, New York, Knopf, 1971.

⁴Lichtenberg, Robert M., One-Tenth of a Nation, Cambridge, Mass., Harvard University Press for the Regional Planning Association, 1960.

literature review revealed four recent articles¹ dealing with measurement of change in service and government labor productivity. All four deal with aggregates of all services at the national level and none make any attempt to support hypotheses about sources of productivity change.

An interview with staff economists at the U.S. Department of Commerce, Bureau of Economic Analysis, Division of Regional Economics,² led to the conclusions that there are no known measurements of true regional productivities in any industry. While such analysis had been considered, it was concluded that adequate data was not available for regional analysis. Even at the national level where there are available more extensive economic accounts than for any region, attempts at analyzing sectoral productivity changes have met with only mixed success, and analysis of the sources of productivity increases have been extremely conjectural.³

¹Michael Grossman and Victor Fuchs, "Intersectoral Shifts and Aggregate Productivity Changes," Annals of Economic and Social Measurement, National Bureau of Economic Research, Volume II, Number 3, July 1973.

Jerome Mark, "Progress in Measuring Productivity in Government," Monthly Labor Review, Bureau of Labor Statistics, Volume 95, Number 12, December 1972.

Edward Denison, "The Shift to Services and the Rate of Productivity Change," Survey of Current Business, Department of Commerce, Volume 53, Number 10, October 1973.

Jack Beebe, "Note on Intersectoral Shifts and Economic Productivity Changes," Annals of Economic and Social Measurement, Volume 4, Summer 1975.

²Telephone conversation on November 10, 1975 with Messrs. Lowell Ashby and Edgar Dunn.

³See citations in Footnote 1.

Two partial surrogates for an indicator of productivity in the service industries (revenue per employee and revenue per payroll dollar) will be analyzed for 1967 and 1972, the years for which data are available. In addition, individual sector or activity case studies (described in Task 4.5) will consider efficiency in the sense that the cost of factors of production for an individual enterprise may have changed in the BART or the NBA scenarios.

B. Research Strategy

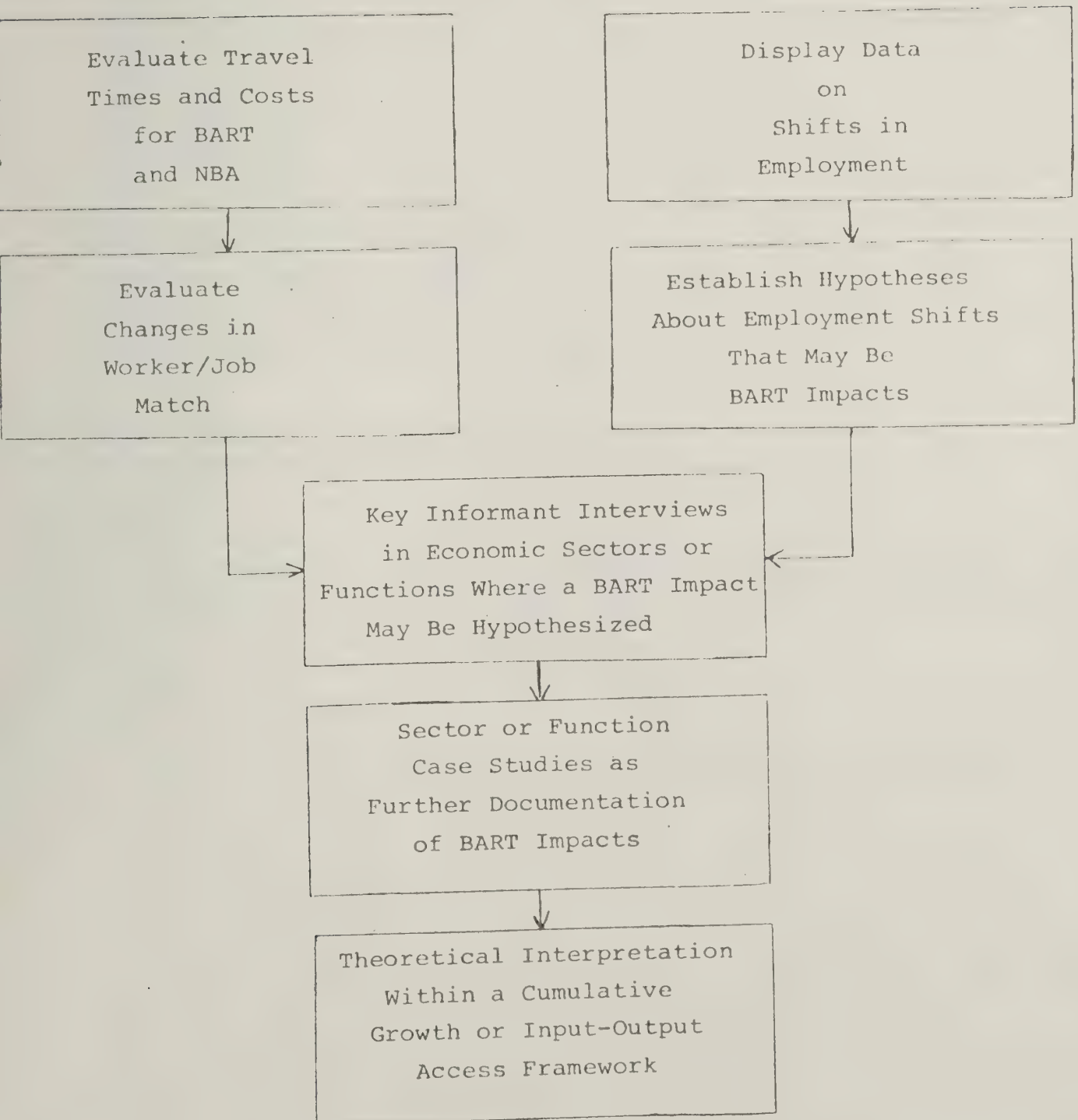
Consideration of available theory, available data, and comparable efforts described in the literature led to the selection of a research strategy summarized in Figure III-2. The effort is described subsequently in terms of specific tasks, but an initial summary may be useful. This summary is intended to show that the sequencing of the tasks is important to the methodology. Insights that are gained, and hypotheses that are tested in the first tasks will guide the interview program and the selection of case studies.

The task will begin with two distinct quantitative evaluations which are each designed to produce data that will support the subsequent interviews and case studies.

The first analysis is that of the transportation characteristics of BART as compared to the NBA. Emphasis will be on measures of accessibility during the work trip but an evaluation will also be made of the cost for movement of goods from

FIGURE III-2

RESEARCH STRATEGY FOR EVALUATION
IMPACTS ON EMPLOYMENT & COMMERCE



outside the region to selected Bay Area locations (particularly the San Francisco peninsula and within the region). This analysis will permit testing of quantitative hypotheses about differences between BART and the NBA regarding access to employment and will also provide insights that can later be tested in the interviews and case studies.

In a parallel effort, a shift/share analysis will be used to document what in fact has been the change in competitive position of the Bay Area employers compared to other areas in the Western United States and throughout the United States. This analysis identifies those industries where a given locality has received more than its "share," considering national trends and initial position of the industry.

Shift/share analysis is discussed in the literature¹ and is often used in practice as a technique for forecasting inter-

¹For a general application of shift/share analysis to the Bay Area, see Association of Bay Area Governments, Economic Activity in the San Francisco Bay Area, Technical Report, August 1971, p. 368 ff. For detailed discussions and applications of shift/share analysis to regional analysis see:

Ashby, Lowell, "Shift and Share Analysis: A Reply," Southern Economic Journal, 1969;

Davis, H. W., R. G. Newsom, D. E. O'Neill, "Rate Weight Analysis: A Suggested Technique for Examining Regional-National Growth Rate Differentials," Annals of Regional Science, December 1971, Volume V, Number 2, pp. 1-7.

Esteban-Marquillas, Jim, "A Reinterpretation of Shift-Share Analysis," Regional and Urban Economics, Volume 2, Number 3, 1972, pp. 249-255;

Houston, D. B., "Shift and Share Analysis of Regional Growth: A Critique," Southern Economic Journal, Volume 34, 1967, pp. 577-581;

MacKay, D. B., "Industrial Structure and Regional Growth," Scottish Journal of Political Economy, Volume 15, 1968;

Stillwell, F. J. B., "Regional Growth and Structural Adaptation," Urban Studies, Volume 1, 1971, pp. 77-87.

regional industrial growth. As such, the technique has been criticized because of a lack of a theory of the causal mechanism behind an historically-observed fact that a region's share of a particular industry has shifted over time. This criticism does not apply to the use of a shift/share analysis as a technique for analyzing and interpreting historical data.

The shift/share analysis does not specifically demonstrate any BART impact. It does, however, produce a convenient summary of data that may suggest the sectors where a competitive advantage or disadvantage for the Bay Area can be seen to exist and be plausibly related to a BART impact.

The data summary is based on an identity relating to employment in each sector. If the following notation is used

E_{ij_t} = Some measure of activity (normally employment) in industry i in region j at time t ,

$E_{i_t} = \sum_j E_{ij_t}$ = Total activity in industry i

$E_t = \sum_i \sum_j E_{ij_t}$ = Total activity,

$\Delta E_{ij_t} = E_{ij_t} - E_{ij_{t_0}}$,

the simple shift/share model can be formulated as an identity:

$$\Delta E_{ij_t} = E_{ij_{to}} \left[\left(\frac{E_t}{E_{to}} - 1 \right) + \left(\frac{E_{i_t}}{E_{i_{to}}} - \frac{E_t}{E_{to}} \right) + \left(\frac{E_{ij_t}}{E_{ij_{to}}} - \frac{E_{i_t}}{E_{i_{to}}} \right) \right]$$

Average
Total
Increase

Industrial
Mix

Competitive
Position

The third term in the equation isolates shifts in the share of industry i that are specific to the region.

The straightforward simplicity of this model does not negate its usefulness in analyzing a large amount of employment data to detect shifts in competitive advantage. The data supports a strategy of learning first what hypothesis can be supported by available data before beginning a more focused program of interviews/case studies. The shift/share model does not explain why shifts have occurred but the results provide a basis for informed conjecture about whether any of the shifts could be related to BART's existence.

The next step in the sequence is to evaluate individual economic sectors or activities that may have experienced significant BART impacts. An interview program will be designed and carried out to evaluate:

- the role of mass transit in location decisions (whether the location choice was to move to the Bay Area, to leave, or to stay);
- perceptions and conclusions about operating efficiencies in selected sectors and occupations; and

-- effects of BART on decision-makers' attitudes about the San Francisco Bay Region as a place to locate or invest.

Table III-3 lists economic sectors that may have experienced a BART impact. This list is a preliminary, but necessary, device to be used only in preparing the task budget. It does not represent a premature conclusion, ahead of an objective evaluation, of the shift/share analysis, the accessibility analysis, and the interviews. Also, it does not preclude the hypothesis that certain economic activities (e.g., home-office activities) common to several sectors may have experienced an impact. In fact, every consideration will be given to BART's impacts on activities or occupations that may be common to more than one of the economic sectors that are defined in the Standard Industrial Classification (SIC) system.

Intensive case studies will be selected after the evaluation of aggregate data and after the program of interviews. The individual case studies cannot be identified until the analysis and interviews are completed, and the number of cases cannot be determined. The intent of the case studies can be specified however. Each case will be intended to confirm or refute an economic advantage because of a confirmed or hypothesized impact of BART or NBA. For example, if a shift of the share of California's legal services to the Bay Area is indicated, interviews and cost studies of the legal profession will be undertaken to determine whether this shift can be attributed to BART or the NBA. In effect, the case studies are a search for direct causality, if the data suggests that there is a correlation between a BART or NBA characteristic and a shift in economic activity.

TABLE III-3
SECTORS EXPERIENCING AN IMPACT
INITIAL CONJECTURES

MANUFACTURING

Printing, publishing and allied industries
Transportation equipment

TRANSPORTATION, COMMUNICATIONS, UTILITIES

Motor freight transportation and warehousing
Transportation services
Communication
 Radio and television broadcasting

WHOLESALE TRADE

RETAIL TRADE

FINANCE, INSURANCE & REAL ESTATE

SERVICES

Hotels
Business Services (especially advertising; consumer credit, etc.;
 mailing, reproduction, etc.; computer & data processing; and
 management, consulting, and public relations services).

Legal Services

Membership Organizations

PUBLIC ADMINISTRATION

General Government

It should be understood that the interviews and case studies will be undertaken even if the results of the shift/share analysis are inconclusive (i.e., if the results cannot plausibly be related to a characteristic of BART or the NBA). In such an event, the case studies would be a search for BART impacts directed only by judgment rather than be conclusions inferred from data.

Conclusions from the case studies will be analyzed in terms of their significance for the Bay Area economy. If cases exist where the impact on profit or value added can be estimated quantitatively, the results will be extrapolated over the sector or activity being analyzed. In each case, however, a qualitative analysis will be provided.

The possibility of BART impacts on the "export" portion of regional final demand cannot be dismissed at this point. If, for example, an increase in tourism can be associated with BART (compared with the NBA) and if it can be estimated quantitatively, the input-output model (Task 3) would be used to convert this increase in final demand to overall direct and indirect economic impact in the Bay Area.

The search for impacts of BART or the NBA on the Bay Area economy will, in some cases, concentrate on selected geographic areas where judgment suggests such effects might be concentrated. Similarly, in Task 5 certain fiscal impacts of BART are illustrated by reference to the impacts on households living within selected political jurisdictions, each having

distinct fiscal characteristics and tax bases. The political jurisdictions used by analysis or example are summarized below with the rationale for this selection:

San Francisco	The Bay Area's major employment center and the leading candidate for agglomeration economies. San Francisco also has a strong non-residential tax base, and a significant minority population.
Oakland	A major urban center with some indications of agglomeration economies, with a downtown redevelopment project directly affected by BART, with a significant minority population and with a declining tax base.
Hayward	A model for the dispersion of industrial growth to suburban areas and an appropriate testing ground for improvements in access to suburban employment by center-city residents.
San Leandro	A suburban city with a traditionally strong non-residential tax base and a generally perceived positive climate for location of business activity - a position that may have been improved because of the existence of BART.
Fremont	A suburban location with well-established opportunities for both skilled and unskilled labor. Accessibility to this employment by center-city residents may have been improved because of BART.
Berkeley	A major white collar employment center that also has a significant minority population. In addition, Berkeley has interesting fiscal characteristics because it funded the BART subway from its local tax base.

Richmond	A traditional industrial center with excellent BART access and with a significant minority population.
Orinda	A high-income residential community that has often been used as the stereotype of the political jurisdiction and the type of household that will benefit by improved access to San Francisco's financial district.
Walnut Creek	A residential community with increasing amounts of commercial office space. It may illustrate both the effects of improved access to the downtown centers of San Francisco and Oakland and the opportunity for suburban commercial activities to draw from a labor force located in the entire BART service area.
Concord	A middle income community with a predominately residential tax base.

Table III-4 summarizes the hypotheses about BART's impact on employment and commerce that will be tested during the task. This listing provides a succinct summary of the classes of questions of Bay Area and national decision-makers that may be answered during the task.

It must be noted that certain of these hypotheses - particularly the ones related to increased efficiency of business operations - are for purposes of illustration. Exact hypotheses cannot be formulated until the data analysis tasks have been completed. In fact, the basic research strategy is to seek "circumstantial evidence" (not statistical proof) from the data and to follow such evidence with more qualitative techniques - interviews and case studies - that will be used to identify BART impacts.

IMPACT	HYPOTHESIS	METHODOLOGY	TASK	COMMENTS
Transportation Service and Accessibility	1. BART and NBA are equivalent in terms of access to employment for both non-minority and minority members of the labor force.	Comparison of 1976 network characteristics of BART and NBA's. Selected interviews related to minority employment.	4.2	This hypothesis is subject to change after interviews. A conclusion from LU/UD about increased industrial employment in Hunter's Point (under an NBA) is, in part, an impact related to access to employment.
	2. BART provides no cost advantage for inter-regional goods movements.	Freight rate comparisons to substantiate an estimate of rates for each NBA.	4.1	The underlying hypothesis is that congestion is not improved with BART.
	3. BART's service <u>per se</u> contributes to efficiency in the Finance/Ins., Services, and Public Administration sectors and to home office functions in other sectors.	Interpretation of on-board surveys of business day travel plus interviews and case studies.	4.7	The research itself is not limited to the sectors slated as positive hypotheses.
Competitive Advantage	1. Analysis of data suggests a locational advantage due to BART in the Finance/Insurance sector.	Shift/share analysis for the Bay Area and for other SMSAs.	4.3	
	2. BART was a significant, though subjective, consideration in locational decisions.	Key informant interviews.	4.4	Shift/share comparisons may support the contrary hypothesis.
	3. BART was a significant consideration in recruiting technical and management personnel to the Bay Area.	Key informant interviews.	4.4	
Continued next page				

Table III-4, Continued

IMPACT	HYPOTHESIS	METHODOLOGY	TASK	COMMENTS
Competitive Advantage (Continued)	4. BART contributed to final demand and, thus, Bay Area growth through the tourist-related and Finance/Insurance sectors.	Shift/share analysis confirmed by interviews and (limited) travel surveys. Ultimate incidence by means of the I-O model.	4.3 4.5	The final demand impacts may be extremely difficult to estimate.
Economic Efficiency	1. Assumed density increase and agglomeration because of BART produced a net increase in efficiency in the Finance/Insurance, Business Services, and Legal Services sectors.	Industry cost comparisons plus followup interviews.	4.4 4.5	The actual sectors to be reviewed in-depth (if any) will be selected after the data analysis and first-round interviews.
	2. Residential location impacts had no measurable impact on business efficiency.	Same as above plus, possibly, review of labor-management agreements.	4.4	

A final word is appropriate regarding the purposes that will be served by this task. The methods used to test the impact of access to employment, and economy in movements of goods, are applicable to any project evaluation. The evaluation of operating efficiency is "case study" oriented and is more easily applied to an after-the-fact evaluation than to prediction of overall impacts of a transit system that has not yet been initiated.

C. Annotated Bibliography

1. Agglomeration Potential Models

Czamanski, Stanislaw. "A Model of Urban Growth." Papers and Proceedings of the Regional Science Association, Vol. 13, pp. 179-203.

Determines degree of cluster economies for various industries using I-O industrial complex analysis.

Karaska, G.J. "Manufacturing Linkages in the Philadelphia Economy: Some Evidence of External Agglomeration Forces." Geographical Analysis, Vol. 1, 1969, pp. 354-369.

Kawashima, Tatsuhiko. "Urban Agglomeration Economies in Manufacturing Industries." Papers and Proceedings of the Regional Science Association, Vol. 34, 1975.

Demonstrates agglomeration economies in urban manufacturing activities.

Richardson, Harry W. "Agglomeration Potential: A Generalization of the Income Potential Concept." Journal of Regional Science, Vol. 14, No. 3, December, 1974, pp. 325-337.

Reviews various economies of urban agglomeration and develops a model of weighted factors influencing per capita land values (a proxy for income potential).

Sakagami, Koyo, Nobuyoshi Koboyashi, and Ryoichi Kinoshita. "Economic Potential and Its Application for a Regional Growth Model with the Investment Plan of Transportation Facilities." Annals of Regional Science, Vol. III, No. 2, December, 1969, pp. 1-14.

Develops an income potential model utilizing gravity equations to estimate the impacts of transportation investment on Tokyo economic activity.

Sveikauskas, Leo. "The Productivity of Cities." Quarterly Journal of Economics, Vol. LXXXIX, No. 3, August, 1975.

Investigates relationship between manufacturing labor productivity and city size.

2. Improved Shift/Share

Ashby, Lowell. "Shift and Share Analysis: A Reply." Southern Economic Journal, 1969.

Defends shift/share and discusses aggregation level problem.

Houston, D.B. "Shift and Share Analysis of Regional Growth: A Critique." Southern Economic Journal, Vol. 34, 1967, pp. 577-581.

Good critique of shift/share.

MacKay, D.C. "Industrial Structure and Regional Growth." Scottish Journal of Political Economy, Vol. 15, 1968.

Applies shift/share to analyze regional development and wage differentials in England.

Stillwell, F.J.B. "Regional Growth." Urban Studies, Vol. 6, 1969, pp. 162-178.

"Further Thoughts," Regional Studies, Vol. 4, 1970, pp. 451-458.

Regional and Urban Studies, Vol. 1, 1971, pp. 77-87.

Develops shift/share for regional comparisons and modifies to eliminate the "index number problem" (shifting structural base).

3. Annual Shift/Share Analysis and/or Analysis of Variance

Harris, Curtis. The Urban Economies 1985. Lexington Books, 1973.

Econometric forecasting framework incorporates agglomeration and proximity variables.

Harris, Curtis. "State and County Projections: A Progress Report of the Regional Forecasting Project." Occasional Paper Series BEA, University of Maryland, January, 1969.

Employs annual component shift analysis to predict regional economic activity.

Hirsch, Werner Z. Urban Economic Analysis, McGraw-Hill, 1973, pp. 223-231, 259-263.

Presents applications, critique, and theoretical expansion of the shift/share identity.

4. Industry Case Studies

Hoover, Edgar M. An Introduction to Regional Economics. New York: Knopf, 1971.

Reviews externalities and cluster economies.

Lichtenberg, Robert M. One-Tenth of a Nation. Cambridge: Harvard University Press (for the Regional Plan Association), 1960.

Extensive case study of New York industry based on cluster economies.

Perloff, Harvey S., E.S. Dunn, Jr., Eric E. Lampard, and Richard F. Muth. Regions, Resources and Economic Growth. Baltimore: Johns Hopkins University Press, 1960.

Developers of input-output access theory of regional development, large-scale application to U.S. regions.

Perloff and Wingo. Issues in Urban Economics. Baltimore: Resources for the Future, Inc., 1968. pp. 63-78.

5. Regional Productivity and BART Impacts

Denison, Edward F. "Major Issues in Productivity Analysis." U.S. BEA, May, 1969.

Mark, Jerome. "Meanings and Measures of Productivity." Public Administration Review, Vol. XXXII, No. 6, November-December, 1972, pp. 740-747.

6. Impacts on the Regional Economy

Greenwood, Michael J. "Urban Economic Growth and Migration: Their Interaction." Environment and Planning, 1973.

Mills, E.S. Studies in the Structure of the Urban Economy. Baltimore: Johns Hopkins University Press, 1972.

Olvey, Lee Donne. "Regional Growth and Inter-Regional Migration - Their Pattern of Interaction." Review of Regional Studies, Winter, 1972.

Regional Growth Theory, London: MacMillan, 1973.

IV. DISTRIBUTION OF TAX BURDENS

The purpose of our analysis of tax burden is quite straightforward: to identify the incidence of the burden¹ associated with the costs of BART compared to the NBA. (The theoretical framework is a differential tax burden analysis. It will identify those who have and will continue to pay the cost of BART and the NBA and will compare the tax burden patterns of BART and the NBA.)²

The most general definition of the costs of BART or the NBA would include a wide range of effects. The direct capital and operating costs are obvious examples and so are indirect costs such as BART-induced street improvements around the stations. Other costs (e.g., costs of elementary and secondary education for the children of construction workers) may also be BART impacts in the sense that they would not have occurred under the NBA scenario.

Similarly, the final incidence of BART or the NBA's tax burden can be influenced by a wide range of effects. For example, shifts in land use will shift the property tax burden from one jurisdiction to another and differential rates of growth and development between the BART and the NBA scenarios have a similar effect.

The hypotheses to be tested in the analysis are conditioned by two considerations:

- Hypotheses on direct incidence are not based on theory, but comparison of features of the BART and NBA financing plans.

¹"Burden" is defined as the reduction in real income below the level otherwise prevailing. The analysis is ultimately concerned with the question of how real income reductions are spread among households and other taxpayers, even though the analysis begins with incidence of costs upon tax bases (e.g., the property and sales tax bases).

²It should be clearly understood that while "who pays" is a subject of the E&F Project, the parallel question of "who benefits" is not. Instead, this question will be dealt with by the MTC staff later in the BART Impact Program.

- Hypotheses on final incidence relate to theories on property tax, sales tax incidence, effects on location decisions and regressivity/progressivity of these taxes.

This discussion notes areas of theoretical debate, and relates these to the study hypothesis and methodology to indicate areas of special analytical concern in hypothesis testing.

The theoretical framework for the classification of BART's cost by final incidence or "burden" follows closely that of conventional public finance theory on incidence¹ and distributional effects of taxation. In this approach, the direct payers of each tax are first identified and then, on the basis of theory or empirical evidence, an assumption is made about how the tax payment may be shifted either forward or backward, i.e., toward the ultimate consumer or toward the producer.

A. Property Tax Incidence

An initial set of assumptions about the property tax base is shown in Table IV-1. The initial assumption about incidence follows the general theory but is influenced by the fact that in the case of both BART and the NBA a relatively small increment of taxation is being imposed. As discussed further below, the question of incidence will be the subject of limited empirical research and interviews for portions of the tax bases that

¹For a summary and a discussion of both backwards and forward incidence of taxation, see Earl R. Rolph and George F. Break, Public Finance, Ronald Press, 1961, pages 342-347. Conclusions about property tax incidence that have emerged in the last ten years are discussed in Henry J. Aaron, Who Pays the Property Tax? A New View, The Brookings Institution, 1975, pages 18-55. The methodology for estimating impacts of the individual taxes follows the theory presented in D. Netzer, Economics of the Property Tax, Washington, D. C., Brookings Institution, 1966, pages 32-59 and John F. Due, Sales Taxation, London, Rutledge and Keegan Paul, Ltd., 1957, pages 8-29. For a general discussion of distributional effects, see John F. Due, Government Finance: Economics of the Public Sector, Richard D. Irwin, 1968, Chapter 8.

are highly sensitive to local conditions (e.g., rental property) or to a more refined definition of the class of property (e.g., personal property).

TABLE IV-1
FINAL INCIDENCE OF THE PROPERTY TAX

<u>Classification</u>	<u>Incidence</u> (Initial Hypothesis)
Type of Property	
Land	Owner
Improvement	See Below
Personal Property	1
Unsecured Property	Owner
Improvements Classified by Land Use	
Residential-Homeowner	Owner
Residential-Renter	Renter or Owner ¹
Agriculture	Owner
Industrial	Owner
Commercial	Consumer or Owner ¹

¹The question of incidence for this type or use of property must be evaluated further during the E&F Project.

1. Unimproved Property (Land)

The burden of property tax on unimproved property generally is assumed to fall on the landowner. This theory stems historically from Ricardo's rent theory, from Edgeworth, and from Marshall. Academic agreement that no shifting of burden occurs is based on the assumption that the supply of land is fixed and income (rents) is determined by the utility of land, which is unaffected by changes in the property tax rate.

The Bay Area, however, is one of the few regions where the total supply of land is not fixed because of land-fill operations in the bay itself. The question of whether the imposition of BART property taxes affected land-fill choices will be considered in the analysis of the property tax base.

Shifting of land tax burdens can also occur because the supply of land for one use, or set of uses, is not fixed. In the case of unimproved property, a higher tax would increase the incentive to develop if the land is taxed at its highest and best use. Such effects would most likely be on the urban fringes and may emerge from an assessment of changes in land use. The smallness of the BART tax increase, however, makes its impact practically impossible to isolate from other urbanizing influences. Accordingly, we have not included an exploration of this impact in the study.

2. Improved Residential Property

a. Owner-Occupied

The burden of property tax on improved residential property which is owner-occupied generally is assumed to fall on the owner-occupant. Two general theories lead to this conclusion. Netzer (a proponent of the "conventional" wisdom) argues that the burden is on the owner-occupant in the role of a consumer of housing

rather than as an owner of capital.¹ Aaron (the spokesman of the new "revisionist" views) essentially argues the opposite.² Nonetheless, both conventional and revisionist property tax theorists agree that the question of whether the occupant bears the burden as a consumer or as an owner of the asset depends on the extent to which the supply and demand of owner-occupied residential housing can change in response to changes in the cost of housing (e.g., changes in level of property taxes).

Recent empirical work on price-income elasticity of demand for housing would indicate that resolution of this issue is dependent upon income group, since elasticity is not proportional for all income groups.³ In general, however, in the short and intermediate time reference, the supply is fixed and the burden falls on the owner of the asset (who has no other than the occupant -- himself -- to whom to shift the burden).

Over time significantly higher taxes in a jurisdiction would reduce the area's growth rate. For a regional property

¹Netzer, Dick, "The Incidence of the Property Tax Revisited," National Tax Journal, Vol. XXVI, No. 4 (December 1973), pp. 524-525.

²Aaron, Henry J., Who Pays the Property Tax?, Washington, D. C., The Brookings Institution, 1975.

³Recent research in income elasticity of housing includes the following by deLeeuw, who reported permanent income elasticity of rental expenditures about 0.8-1.0 and owner occupied house values to be 1.3 or more. See deLeeuw, Frank, "The Demand for Housing: A Review of Cross-Section Evidence," The Review of Economics and Statistics, Vol. 53 (February 1971). At the same time Muth estimated the permanent elasticity of housing expenditure in the 1.2 to 1.3 range. See Muth, Richard F., "Permanent Income, Instrumental Variables, and the Income Elasticity of Housing Demand," Institute for Urban and Regional Studies, Washington University Working Paper EDA 12, (December 1970). See also Richard Muth, "The Demand for Non-Farm Housing" in Arnold C. Harberger (ed.), The Demand for Durable Goods, Chicago: University of Chicago Press, 1960, pp. 29-96.

tax as small as BART, the effect may not be perceptible. Reduction in housing investment important enough to affect the construction industry seems unlikely. Even if differential growth rates were evident, the construction industry would be able to move into lightly taxed, faster growing counties, so that no backward shifting of the tax increase would be possible.

b. Renter Occupied

Although the "revisionist" theory that burden is shared by asset-owners and renters is becoming widely accepted, substantial debate on the incidence of the property tax in renter-occupied housing continues. Netzer makes a strong argument in the "Incidence of the Property Tax Revisited" that there is no substitute for empirical, location-specific investigation since the factors affecting the shift of tax burden and the regressivity or progressivity of this incidence depend upon market conditions in a given geographic area over a given period of time.¹

As a general rule, shifting of the incidence is determined by the relative substitution in consumption (demand) and production, (supply) and the regressivity or progressivity of the tax is determined by the effective tax rate (T/V , where T is the tax rate, and V is the value of housing or housing expenditures) over the range of incomes.

¹Netzer, p. 515.

The conditions affecting substitution and consequently regional demand and supply levels, which are germane to our analysis include:

- Mobility of renters to locate out of a taxed area;
- Mobility of suppliers to produce housing outside a taxed area;
- Tax rate differentials within the region; and
- Effective tax rate differentials over the range of renters' incomes.

Conditions which affect our evaluation of the regressivity or progressivity of the BART related tax burden are inherent in effective tax rates and the following ratios:¹

$$\frac{T}{Y} = \frac{(T)}{(\bar{V})} \frac{(V)}{(\bar{R})} \frac{(R)}{(\bar{Y})}$$

where T = tax on the rented unit
Y = tenant income
V = value of the housing
R = rent

Assessment practices and federal income tax deductions also bear on equity considerations. Value-to-rent ratios are affected by non-uniform assessment practices, ratios which may reflect over- or under-valuing certain types of properties. Non-uniform assessment practices are known to have existed in the Bay Area during the BART "financing period" (particularly circa 1965-1968). Passage of AB 80 in 1966, state legislation which requires uniform assessment of properties at 25% market value, brought on statewide reassessments including substantial increases in assessed values on residential properties in San Francisco. Accordingly, measures of housing values relative to taxes (T/V) or rents (V/R)

¹Aaron, Henry J., op cit, p. 32 and George E. Peterson, "The Regressivity of the Residential Property Tax," Working Paper 1207-10, (Washington: The Urban Institute, 1972).

probably shifted over this period, and will have to be considered explicitly in the hypothesis that BART and NBA financing plans are regressive.

A further element of regressivity not apparent in these ratios emerges from federal income tax deductions which favor homeowners, hence reducing progressivity. Considering the property tax exemption for homeowners, this study hypothesizes that renters pay a higher percentage of BART's property tax costs than non-renters; our analysis will test this hypothesis.¹

Whether the property tax is found regressive may also depend on how taxes relative to income are evaluated. Arguments on effective burdens have recently focused on definitions of income. To date, current (annual) income has been widely used for empirical analysis because data were available. Permanent (normal) or average income data, as suggested by Aaron, is preferable for two reasons. First, household housing decisions are not based on one year's income and, hence, the elasticity of demand for housing using current income is different from elasticity of demand using longer term income. Secondly, with respect to regressivity, the current low income statistics contain households (e.g., retired people) whose status is new and whose housing expenditures reflect held assets, not current

¹We recognize the debate concerning this hypothesis. Some argue that deductibility is a feature of federal individual income tax law and not of the property tax, and hence is irrelevant. In any case, deductibility would presumably apply to both of the tax alternatives that are worth considering -- retail sales and income taxes -- and hence its effects can be ignored in any differential analysis of these revenue sources.

income, which distorts the housing expenditures relative to income at the low end of the range.¹

Empirical work using permanent/average income includes Aaron's Who Pays the Property Tax?, where the author adopted basic data from the University of Michigan, Survey Research Center, Panel Study of Income Dynamics.² Further reference is made to James N. Morgan (ed.) Five-Thousand American Families - Patterns of Economic Progress, Vol. 2, Special Studies of the First Five Years of Income Dynamics (1974). Since this study of the economic and financial impacts of BART will measure burden on "typical households", current income can generally be considered a good approximation of permanent household income. In the case of an average retired couple, however, we will consider their current income over a period of time to estimate their "normal" income level.

3. Improved Industrial and Commercial Property

This study hypothesizes that the industrial property tax associated with BART's financing will fall on property owners and that the commercial property tax will fall on property owners or be shifted forward to consumers. The distinctions on the incidence

¹Aaron, Henry, J., pp. 27-34.

²Aaron, Henry, J., p. 30.

of these burdens were the following:¹ Where industry or commerce in a highly taxed area is export-based (such as the Bay Area), the burden cannot usually be shifted. (For local, service-oriented businesses, the tax is more easily shifted forward to the consumer.) Moreover, if the highly taxed location provides export producers or sellers with an above average return, the increased tax is very likely to be absorbed by them. Finally, where there is separation of ownership of land and facilities from ownership of business operations, the burden will be shared and will depend largely on the mobility of the business operations to relocate to jurisdictions with lower taxes.

This analysis will follow the established incidence theory that the shifting of tax burdens will depend mostly on whether the property supports an export or local service operation. The input-output model developed in Task 3, will designate the export and service sectors of the economy. Task 5 will apply their data by assuming the property tax shift with export sectors and a forward shift to consumers in service sectors. Special attention will be given to service sectors whose customers could avoid the tax by changing their consumption patterns.

¹The best theoretical discussion of incidence of partial taxes appears in Peter M. Mieszkowski's "On the Theory of Tax Incidence," The Journal of Political Economy, Vol. 75, No. 3 (June 1967), pp. 250-262.

B. Sales Tax Incidence

The incidence of BART's sales tax is also subject to additional research. In general, theory supports the assumption that a retail sales tax with exemptions is a tax on consumption; but if patterns of trade with "outside areas" exist, where other areas have either no sales tax or sales tax of a different levy, then the tax may not be shifted forward to the consumer. As an example, San Franciscans have the option to purchase major comparison items (e.g., refrigerators) in San Mateo, so San Francisco refrigerator dealers may be unwilling to shift the burden of the 0.5% sales tax increment forward to the purchaser. Limited empirical research and interviews will be carried out before a final assumption about incidence of the sales tax is made.

Although our study contains no specific hypothesis on sales tax incidence, the hypothesis that the final incidence of BART is regressive assumes implicitly that the sales tax falls on consumer households. This assumption is based on the general theory on sales tax incidence, expounded by Due¹ which treats the tax as an excise tax that is shifted forward to consumers when the tax is general and regionwide.

¹Due, John F., The Theory of Incidence of Sales Taxation, (New York, Kings Crown Press, 1942), and more recently, John F. Due and Ann Friedlander, Government Finance: Economics of the Public Sector (Illinois, Irwin Series, 1973).

Shifting occurs when there are intra-regional tax differences (as in the case of the property tax) that permit purchases to be made in non-taxed jurisdictions. Relevant empirical work on this issue was done by Mikesell (reported in "Sales Taxation and the Border County Problem").¹ Mikesell's regression analysis of Illinois data on population, income and sales tax revenues showed tax differences significantly affected total sales, indicating overall sales, and specifically comparative shopping goods, were adversely affected in the more highly taxed areas. Convenience goods and auto sales were not. Auto sales were not affected because the savings in sales taxes from purchasing outside Illinois was made up by a compensating use tax on vehicles registered in Illinois, but purchased elsewhere. These findings generally support the theory that tax-induced price increases are passed on to consumers and that purchases shift out of the taxed area when the sales tax savings are significant.

Our hypothesis, however, that retail sales taxes may not have been shifted forward by refrigerator dealers is consistent with Mieszkowski's approach² and not inconsistent with Mikesell's empirical findings.

¹Mikesell, John L., "Sales Taxation and the Border County Problem," Quarterly Review of Economics and Business, pp. 23-29.

²Mieszkowski, Peter, "On the Theory of Tax Incidence," The Journal of Political Economy, Vol. 75, No. 3 (June 1967), pp. 250-262.

C. Annotated Bibliography on the Distribution of Tax Burden

Aaron, Henry J. Who Pays the Property Tax? Washington, D. C.: The Brookings Institution, 1975.

Presents "new" view of property tax incidence theory: burden borne by all owners of capital. Forward shift of burden to renters is refuted primarily on the basis that private capital shifts away from higher taxed property where tax rates are not uniform. Capital yield in higher taxed area is reduced. Tax shift forward depends on renter's ability to relocate to lower taxed areas. Argues strongly that taxes are less regressive than Netzer found in 1966.

Break, George F. Agenda for Local Tax Reform. University of California, Institute of Governmental Studies, Berkeley: 1970.

A report on California's local government financing structure that analyzes a variety of tax reform plans, and makes recommendations to the 1968-69 California Advisory Commission on Tax Reform. Treats residential property taxes, local income taxes, sales taxes, business taxes. Includes comparisons of impact of different taxes on tax payer burdens, economic/investment decisions.

Due, John F. The Theory of Incidence of Sales Taxation. New York: Kings Crown Press, 1942.

The accepted classical work on the theory of incidence of sales taxation. Treats incidence under conditions varying from pure competition to monopoly. Chart on retail sales taxation (Chart No. 25) shows effect of tax on price determination that will be followed in Task 5 sales tax incidence analysis.

Due, John F. Sales Taxation. London: Routledge and Keegan Paul, 1957.

Standard reference on sales taxation, nature of the tax, experience with single and multiple stage taxes. Chapter 2 on Sales Tax and distribution of real income is relevant to study analysis of differential tax impacts on typical household groups. Referenced data is from 1950's and must be considered in light of more recent, empirical studies.

Due, John F., and Ann F. Friedlander. Government Finance: Economics of the Public Sector. Homeward, Illinois: Irwin Series, 1973.

The fifth edition of this standard graduate level public finance textbook contains new material on fiscal policy, taxation, public finance alternatives germane to defining

the financing plans for BART (operating deficit) and the NBA. Chapter 8 on income distribution, Chapter 9 on Revenue Structure Decision Making and Chapter 14 on Consumption Taxation deal with concepts of tax burden and incidence relevant to Task 5 analyses.

Meinster, David R. "Property Tax Shifting Assumptions and Effects on Incidence Profiles," Quarterly Review of Economics and Business. Vol. 10 (Winter 1970), pp. 65-83.

Article examines market and cost conditions which serve as a basis for long-run shifting and incidence assumptions. Considers residential property tax and business property taxes. Argues that the tax is less regressive than commonly supposed, and who is "locked in" largely determines final incidence.

Mieszkowski, Peter. "On the Theory of Tax Incidence," The Journal of Political Economy, Vol. 75, No. 3, (June 1967), pp. 250-262.

Article reviews general equilibrium propositions of incidence theory. Theoretically rigorous, non-empirical argument that final incidence analyses has erroneously concentrated on "the use of income" ignoring the other side of incidence, effects on "the source of income."

Mikesell, John L. "Sales Taxation and the Border County Problem," Quarterly Review of Business and Economics. Vol. 11 (Spring 1971), pp. 23-29.

Addresses question, "By how much does an unfavorable sales tax rate differential reduce border county sales?" Reviews literature, analyzes Illinois case, shows statistically significant, positive effects on total sales comparative shopping goods, but not auto sales.

Netzer, Dick. Economics of the Property Tax. Washington: The Brookings Institution, 1966.

This remains the standard, general reference on property tax theory that Task 5 will use, along with Netzer's more recent analysis (1973). Chapter 3, "Who Pays the Property Tax?" and Chapter 5 on geographic tax differentials provide the basis of Task 5 methodologies.

Netzer, Dick. "The Incidence of the Property Tax Revisited," National Tax Journal, Vol. 26. (December 1973). pp. 515-535.

Recent literature has pointed out that an ideal, uniform comprehensive property tax would fall on owners of capital and be progressive in incidence and that even the non-uniform existing property tax is less regressive than conventional theory maintains. Netzer argues that the theoretical analysis of the existing partial tax is so complex that there is no substitute for place specific empirical work on the property tax incidence.

Rolph, Earl R., and George F. Break. Public Finance. New York, 1961.

Standard text on theoretical and technical issues of public finance. Includes summary and discussion of both backwards and forward incidence of property taxation, pp. 342-347 and effect of retail sales taxes on prices and money incomes, pp. 287-295.

V. FISCAL BEHAVIOR

The decision to finance BART with local general obligation bonds may have had both short-term and continuing effects on bond interest rates, on the use of bond debt to finance non-BART capital improvements, and on the fiscal behavior of local officials in areas not directly related to the use of bonded debt. One conjecture is that the very size of the BART bond issue had the effect of increasing interest rates on public agency bonds throughout the Bay Area. A contrary conjecture is that the bond market perceived the investment in BART as an investment in maintenance of the Bay Area's urban core which in turn made the entire region more credit-worthy and deserving of lower interest costs.

Similarly, the BART bond issue may or may not have had a deterrent effect on the willingness of public agency finance officers and elected officials to propose additional bond issues to finance non-BART capital improvements. The increasing use of non-voted debt (e.g., revenue bonds or bonds issued by non-profit corporations) that occurred during BART's construction period may or may not have reflected decision-makers' perceptions of willingness of the electorate to approve additional general obligation bonds.

Finally, the existence of BART's bonds may or may not have affected the willingness of decision-makers to propose public agency spending programs that did not involve capital investments. Under this hypothesis, municipalities or other local governments may have deferred or eliminated new operating programs, changes in employees' salaries, etc. because of concerns about public sensitivity to expenditure levels and tax rates, some of which may have been caused by the BART bonds.

The objective of our study is to determine whether each of the above effects exist and, in the case of the impact of BART bonds on interest rates, to make a quantitative estimate of any such effects. The research strategy that will be used to identify impacts on fiscal behavior occurs in two phases. First, a statistical analysis is carried out to determine whether changes in fiscal behavior and response of the municipal bond market can be inferred from an analysis of data. Then, the statistical analysis is confirmed by a program of interviews with financial decision-makers in the Bay Area and in the national and regional bond market. This two-phase approach assures that the interviews can be conducted within a factual framework. Quantitative data is known to both interviewer and interviewee prior to a discussion of causal relationships and the meaning of the statistical results.

The theoretical framework for the analysis of impact on fiscal behavior can be divided conveniently between the analysis of BART's impact on bond interest rates and the analysis of the impact of BART bonds on other actions of fiscal decision-makers.

A. Impact on Bond Interest Rates

BART debt, just as any major local bond issue, affects other local general obligation debt costs in two different ways. First, BART debt, because it represents an increase in local tax burden, increases the risk of tax delinquencies and thus increases general obligation debt costs. Second, BART debt represents a particular kind of infrastructure investment which increases the local ability to support general obligation debt. This second effect would increase the security of general obligation debt and offset, to some extent, the first effect.

Two hypotheses on fiscal behavior relate to these impacts:

- That BART debt increased general obligation (G.O.) debt rates and thus increased interest rates on other general obligation bonds; and
- That BART, because it represented a substantial investment in infrastructure, increased prospects for growth and thus lowered other debt costs.

1. Increased Debt Increases Interest Rates

The first hypothesis -- that increased debt caused a rise in interest rates -- is based on general capital theory.¹ Interest is defined as the price ratio between present and future claims. The rational investor will maximize the present value of his or her income (attained wealth) stream. He can be persuaded to defer present consumption through investment if the expected future gains are greater than the value of present consumption. This implies an interest-rate/risk-factor relationship that requires increased returns for increased risk. In this hypothesis, the increase in debt amounts to increased risk since increased borrowing by a single borrower increases uncertainties of repayment. Accordingly, for investment to occur under conditions of increased debt and risk, interest rates must rise. This simple theoretical statement ignores more complicated issues of determination of social discount rates which consider public sector versus private sector

¹For a rigorous theoretical discussion, see Jack Hirshleifer, Investment, Interest and Capital, Englewood Cliffs, New Jersey, 1970. Chapters 1-7 deal with investor choices under conditions of uncertainty. See also Michael C. Jensen, Studies in the Theory of Capital Market, New York: Praeger, 1972, for discussion of asset pricing, allocation of capital assets and determination of discount rates for public investment.

discount rates.¹ Our hypotheses on fiscal behavior generally are designed to be empirically testable and, for this reason, simplicity of statement has definite advantages.

The empirical testing of this hypothesis will be through constructing a statistical model that relates BART bonds (interest rates and reoffer yields) to the local bond market which in turn is related to the state bond market and further to the national municipal bond market and to Treasury bill rates. This construction generally follows observed market behavior.

Our approach is not unprecedented. Alan Rabinowitz in Municipal Bond Finance and Administration² recognizes the relationship of a particular new bond issue to local and national bond market conditions and presents a relevant description of the effect of market conditions on underwriters' evaluations of the BART Series G \$70 million bond offering in June, 1967. Rabinowitz compares BART bond yield scales and coupon rates with Bond Buyer average yields over time.

Another largely empirical study that relates to the theory behind this first hypothesis is Helmut Wendel's Interest Rate Expectations: Tests on Yield Spreads Among Short-Term Government Securities.³ This study provides data on the size of debt (using balance of payments deficits) and changes in Treasury bill rates that empirically demonstrate the relationship between debt size and interest rates.

¹For discussion of social discount rates, see Arnold C. Harberger, "On Measuring the Social Opportunity Cost of Public Funds," Proceedings of the Committee on Water Resources and Economic Development of the West: The Discount Rate in Public Investment Evaluation. Denver: Western Agricultural Research Council, 1968.

²Alan Rabinowitz, Municipal Bond Finance and Administration: A Practical Guide to the Analysis of Tax Exempt Securities. New York, 1969, pp. 3-11.

³Helmut F. Wendel, Interest Rate Expectations: Tests on Yield Spreads Among Short-Term Government Securities, Board of Governors of the Federal Reserve System, June, 1965.

These effects are really perceptions which may or may not mirror reality. Whether they are in rating agencies, banks, insurance companies, or underwriting departments, the same individuals or teams of analysts who appraise BART bonds appraise virtually all general obligation bonds in the BART counties. Their changing view of BART over time influences their view of other issues secured by the same tax base.

The research problems reduce to how to identify bond buyers' perceptions. In the marketplace, perceptions are evidenced by price. In the bond market, prices are expressed usually in terms of net interest costs or yield. A number of separate effects must be considered.

National Market. The municipal¹ bond market is, of course, only part of a much larger securities market which, in turn, is part of a much larger economic system. The relative position of the municipal bond market can be measured rather straightforwardly. Interest rates for grade AA municipal bonds are usually about 80 to 90 basis points (0.8 to 0.9 percent of interest) below Treasury bill rates (T).

The borrowing costs for municipal issuers generally is reflected by the Bond Buyer 20-bond index (BB). Until recently, the index has been considered to reflect primarily national rather than regional economic concerns on a week-to-week basis. Most of the effect of changing national policies and markets can be screened from the index by relating it to the Treasury bill rate for the same period. The difference ($T_t - BB_t$) shows the attractiveness of AA-rated bonds relative to other investment opportunities at the same point in time (t).

¹The term "municipal bond" includes all local government bonded debt, not just the debt issues of municipalities.

For periods during which municipal bonds are perceived as unattractive relative to other securities, the basis point difference may drop as low as 60 to 70 basis points. For periods during which municipal bonds are perceived as more attractive, the basis point spread may increase up to 100 basis points. The interest rate on any particular local bond issue is strongly affected by national market conditions expressed by $(T_t - BB_t)$.

State Market. Another factor relating to the cost of a particular bond issue is the state market. Rating agencies, banks, insurance companies, or underwriting departments will view a particular local issue in the context of the vigor of its state economy. Over the past decade, California bond issues have paid decreasing interest rates relative to the national market. This relative position of the California market can be found by comparing a California bond index (CB) to the Bond Buyer index. The difference $(BB_t - CB_t)$ shows the position of the California bond market relative to the rest of the bond market.

The approach to relating local issues to national and state markets views the municipal bond market as a capsule floating in the sea of the economic system. The difference $(T_t - BB_t)$ measures the relative position of the overall municipal market in the sea. The difference $(BB_t - CB_t)$ measures the relative position of the state market within the capsule. Any particular bond issue may be positioned by comparing the net interest cost bid (I_i) to the Treasury bill rate. The difference $(T_t - I_i)$ measures the relative position of a particular issue.

Local Effects. Interest costs on local general obligation bond issues are affected by more than national and state markets. Some factors which conventional wisdom says affect interest costs on a particular issue are size of the issue and the ratio of direct and overlapping debt to the assessed value.

The size of an issue is important because it affects the number of bids. In a statistical study of the determinants of interest costs, it will be important to limit discussion to issues which have more than one bidder.

The ratio of debt to assessed value (D/AV) can be a measure of the extent to which taxes (or taxing capacity) have already been encumbered. BART debt did represent a substantial increase in debt ratios for local jurisdictions in BART counties. If BART debt has increased the cost of borrowing for other local purposes, the increase is likely to be because BART debt and tax subsidies were perceived as competing directly with other claims for tax support.

2. BART Improvements Diminished Interest Rates

The second hypothesis -- that BART represented a significant infrastructure investment (in transportation) that increased prospects for growth and, hence, lowered other debt costs -- has its theoretical foundation in the idea that the transportation improvements reduced the uncertainty of selected types of other investments considered after the decision on BART was made. That is, future investments related to transportation, such as large central facilities dependent on reliable mass transit, appeared more assured of success, profit, and debt repayment because of BART. Effectively, BART reduced some investment risk and, accordingly, the interest rate on other debt costs on these kinds of investments.

Hirshleifer, in Investment, Interest and Capital¹, presents a choice theoretical framework of investor preferences under uncertainty, which directly applies to this hypothesis. Specifically, his investor decision rules require the investor to:

¹Hirshliefer, p. 261.

"(1) adopt that set of projects maximizing the attained wealth of the economic agency (the present certainty - equivalent value, PCEV, of the...income stream attained as a result of productive investment);

"(2) adopt that set of projects maximizing the overall wealth gain of the economic agent (the difference between the PCEV of the attained and of the endowed income streams);

"(3) adopt any project as an increment if and only if its separably calculated PCEV is positive."

Under this set of rules, we would expect investments complementary to BART to have somewhat higher income streams and/or lower debt costs.

The theoretical approach we shall follow will attempt to analyze BART's perceived impact within this context. The appraisal of BART bonds themselves as a security also reflects on other general obligation bonds in the three counties. If BART bonds were viewed as strong investments, their presumed tax burden effect may be offset. The interest rate on BART bonds (both net interest costs and reoffer yields), represented by I_t^B would reflect such strength.

The following model for bids on local bond issues in the three BART counties reflects these forces:

$$(T_t - I_i) = f [(BB_t - I_t^B), (D/AV)_i, (BB_t - CB_t)_i, (T_t - BB_t)] \text{ where:}$$

T_t is the Treasury bill rate for week t.

I_i is the net interest cost bid for issue i.

I_t^B is an index of BART interest rates and reoffer yields for week t.

$(D/AV)_i$ is the ratio of debt (direct and overlapping) to assessed valuation.

BB_t is the 20-bond Bond Buyer index for the week t.

CB_t is a California bond index (to be constructed) for week t.

B. Impact on Fiscal Decision-Making

The late 1960's and early 1970's saw growing taxpayer resistance to increases in local property taxes. Many factors have increased property taxes. Among these are more uniform assessment practices which raised the share of taxes borne by homeowners, governmental outlays for new social and welfare programs, and high levels of inflation in all aspects of the economy.

The impact of BART taxes necessarily must be evaluated against this background of increasing local taxes in the late 1960's and early 1970's. During this period, BART taxes at first increased and then declined relative to total state and local taxes. During this period, BART taxes have been highly visible and readily identifiable, both as the 0.5 percent sales tax and on property tax bills. They also have been widely publicized.

The question is whether BART taxes affected the willingness of public officials to propose general obligation bonds to the voters or to propose other spending programs unrelated to bonded debt. To answer these questions, the second major effort in evaluating the fiscal impacts of BART proposes to examine some of the signals provided by the public to policy-makers through voting on general obligation bond issues.

Two hypotheses formulate these questions:

- BART's debt-related tax burden decreased voters' willingness to approve other bond issues, BART and non-BART related; and
- BART debt discouraged policy-makers from submitting bond issues for public approval and thus increased the volume of non-voted bond issues.

1. Increased BART Taxes Decrease Voter Bond Approvals

General obligation bonds may be repaid from project revenues, from taxes, or from both project revenue and taxes. Bonds to be paid wholly from property taxes most directly challenge the voter to weigh his view of the project against his innate resistance to higher taxes. There may have been an observable correlation between election failures of general obligation issues and tax levels which would support the view that voters responded to higher taxes by turning down bond proposals

The hypothesis on voter behavior, that the increased tax burden BART created decreased voter willingness to approve bond issues that would further increase the tax burden, is generally treated in several works on the economic theory of politics, including Wilson and Banfield, "Voting Behavior in Municipal Public Expenditures," Buchanan and Tullock's The Calculus of Consent, and Buchanan's The Demand and Supply of Public Goods.

A more specific theoretical framework is presented in "An Economic Interpretation of Voter Behavior on Public Finance Issues" by Rene Frey and Leopold Kohn.¹ Their research proceeds from some of the above economic theories of politics to a model that includes:

- Private opportunity costs (benefits from alternative private expenditures);
- Public opportunity costs (benefits from alternative public expenditures); and
- Expected tax increases.

¹ Rene Frey and Leopold Kohn, "An Economic Interpretation of Voter Behavior on Public Issues," Kyklos, Vol. 23, No. 4, 1970, pp. 792-805.

The authors theoretically analyzed the weight that these different cost categories have in utility for the voters of different income classes and then empirically tested their hypotheses by using poll data on finance referenda from the Canton Basel-Stadt. While this article does not directly consider sequential effects such as one project costing so much that a second project is rejected at the polls, it hypothesizes that:

- Voters who pay taxes take account of the private opportunity costs of a public expenditure program; and
- That expected tax increases reduce voter approval.

From this, we continue to a hypothesis that voter approval of bond issues will decline in relation to increases in taxes to finance public projects.

The empirical test proposed for the BART-voter hypothesis is entirely original although it reflects the basic relationships between voter behavior, taxes, and income that are expressed in some of the theoretical pieces cited above. The hypothesis that

$$I = f \left[\frac{BT}{Y}, \frac{NBT}{Y} \right]$$

or

$$I = g \left[\frac{PT}{Y}, \frac{ST}{Y} \right]$$

Where $I = \Sigma \frac{(\text{Affirmative Vote on Issue } i)}{(\text{Total Votes on Issue } i)} (\text{Dollar Value of Issue } i)$

Y = Gross income.

BT = BART property and sales tax collections.

NBT = Non-BART property and sales tax collections.

PT = Aggregate (BART plus non-BART) property tax collections.

ST = Aggregate sales tax collections.

will be tested through a comparison of voting behavior in BART and non-BART counties. If a statistically reliable relationship is found, a regression model of voter behavior on bond issues in selected jurisdictions over a specified period of time will be run. This subsequent analysis will attempt to construct an index of voting behavior that shows voter resistance varies inversely with voters' perceived tax burden.

2. Voter Resistance to BART Taxes Increases Non-Voted Debt

A second potential impact of high taxation is a reluctance of decision-makers to put important projects to a vote. Some ways of avoiding votes are through joint power authority, redevelopment agency, and non-profit corporation bonds.

This hypothesis -- that BART debt discouraged policy-makers from submitting bond issues for voter approval -- loosely relates to political economic theories and directly to the practical world of municipal bonds. Alan Rabinowitz' textbook on tax exempt bonds, Municipal Bond Finance and Administration, very effectively describes the decision-making roles of local municipal finance officers and bond underwriters, stressing practical issues of bond ratings, debt management, and the real lack of guidelines or theory in selecting alternative bond financing methods.¹ Our literature search confirms that theory is generally lacking in this area of municipal finance decision-making,

¹Rabinowitz, pp. 43-49.

where something did not happen, because of something else. And for that reason, the empirical findings on the value of non-voted bond issues in relation to tax burdens and voter sentiments could be very important to cities evaluating BART-like transportation improvements.

The amounts of non-voted bond issues from year to year, adjusted by the applicable building cost index and for increases in assessed value, can be studied in relation to the previously developed index of voter sentiment (I). The hypothesis is that the adjusted dollar value of non-voted bond financing will vary directly with the electorate's tax burden and inversely with the county's historical experience as to voter sentiment. Using the voter sentiment index for the previous time period as a proxy for historical experience, the relationship becomes:

$$V_t = f (TB_t, I_{t-1})$$

Where V_t = aggregate dollar value of non-voted bond issues in a given period of time, divided by assessed valuation.

TB_t = present tax burden, where $TB = \frac{PT + ST}{Y}$ as above.

I_{t-1} = index of voter sentiment during the previous time period.

If V_t is significantly related to tax burden, to voter sentiment, or both, it can be concluded that bonded debt, including the BART debt, did in fact influence public policy-makers through its contribution to tax burden and voter sentiment.

After a statistical analysis, interviewees can be asked what pressures existed to resort to a non-voted procedure or why a non-voted procedure was used, instead of submitting a bond issue to the electorate.

C. Annotated Bibliography

Adams, Chuck. Bidding on Municipal Bonds Under Uncertainty.
Berkeley: University of California (Master's Thesis), 1972.

The thesis presents bidding strategies under certain and uncertain spread and bond yields. It develops a linear programming model for selecting optimal coupon (interest) rates on bonds. The model requires a probability distribution for yields and bidding and a specified underwriter's utility function. It can then solve for the minimal net interest cost and give a lower bound or minimal bid solution.

Frey, Rene and Leopold Kohn. "An Economic Interpretation of Voter Behavior on Public Finance Issues, Tested Empirically by Using Poll Data from the Canton Basel/Stadt, Switzerland," Kyklos, Vol. 23, No. 4, 1970, pp. 792-805.

In this paper, the voting behavior on public finance issues is examined. The authors presuppose that individuals do reveal their true preferences in referenda and that, therefore, it is possible to explain their underlying utility calculus. For this purpose, different cost concepts are introduced: (1) private opportunity costs (benefits from alternative private expenditures); (2) public opportunity costs (benefits from alternative public expenditures); and (3) expected tax increases. Having analyzed theoretically the weight these different cost categories have in the utility calculus of the voters of different income classes, the determinants of the utility of public projects are examined. The results of this theoretical reasoning are tested empirically in the last part of the paper by using poll-data from the Canton Basel-Stadt (Switzerland). On the whole, the empirical tests confirm the derived hypotheses.

Harberger, Arnold C. "On Measuring the Social Opportunity Cost Of Public Funds," Proceedings of the Committee on Water Resources and Economic Development of the West: The Discount Rate in Public Investment Evaluation. Denver: Western Agricultural Economics Research Council, 1968.

Considered the definitive treatment of appropriate allowance for distortions (e.g., taxes on bonded debt) in project investment evaluation.

Hirshleifer, Jack. Investment, Interest and Capital. Englewood Cliffs, New Jersey, 1970.

Reviews development of capital theory, expands Fisher's model of capital and interest using concepts of the firm and capital as separate factors of production. Chapters 8-11 deal with investor choices under conditions of uncertainty and are theoretically applicable to the hypothesis on BART's increasing prospects for regional growth and thus reducing other debt

costs. Also, Chapter 9, "Investment and Interest Under Uncertainty: Choice Over Dates and States," builds a general model of investor choices that includes evaluation of subjective probabilities of various future states occurring, a case related to the hypothesis of reduction in the number of bond issues offered for voter approval.

Jensen, Michael C. (ed.). Studies in the Theory of Capital Market. New York: Praeger, 1972.

Comprehensive theoretical treatment of asset pricing, allocation of capital assets, oriented toward portfolio theory. Part IV on applications of theory includes determination of the discount rate for public investment (pp. 269-293) and considers effects on the "portfolio of each household." Supports methodology in Task 6 on effect of debt burden on interest rates and voter willingness (unwillingness) to increase bonded debt.

Mishan, E.J. "Criteria for Public Investment: Some Simplifying Suggestions," The Journal of Political Economy, LXX V, April, 1967, pp. 139-146.

A theoretical article that argues social discount rates should be the private market rate, that discounting future return at a "social rate" is invalid. "For any social rate of discount, the opportunity cost of a dollar of public investment is irrespective of whether funds are raised...by taxation in the bond market...or both." (p. 143) This means the opportunity yield on all public investment funds is derived the same way. The article also argues against "perpetual reinvestment procedure" posited by Marglin, with Mishan saying that reinvestment will occur only when the particular project can compete with private investment opportunities.

Modigliani, Franco and Kalman J. Cohen. "The Role of Anticipations and Plans in Economic Behavior and Their Use in Economic Analyses and Forecasting." Urban (University of Illinois Bulletin), 1961.

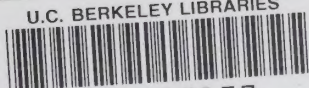
Contains systematic exploration of possible uses of statistical data bearing on anticipation and plans of firms, also relevant to understanding public economic behavior and decision-making. Study involved interviews that suggested (not tested) hypotheses and emphasized "that plans had almost no binding effect on further operations."

Rabinowitz, Alan. Municipal Bond Finance and Administration. New York, 1969.

This textbook gives excellent practical coverage of topics usually ignored in academic literature. Part 1, "How the Municipal Bond Market Works," treats market mechanisms, underwriters' functions, provides guidelines to local government on debt management and bond financing, and, lastly, interprets investor behavior. BART Series G bonds are presented as a case study. Parts 2-4 treat issues in tax exempt finance, problems in municipal bond evaluations, and the outlook for this long-term municipal financing method. The threat BART case study is loosely woven through much of the text.

Wendel, Helmut F. Interest Rate Expectations: Tests on Yield Spreads Among Short-Term Government Securities. Washington, D.C.: Board of Governors of the Federal Reserve System, June, 1968.

Contains review of studies of term structure of interest rates. Provides data on size of the debt (using balance of payments deficits) and changes in Treasury bill rates that empirically demonstrate the correlation of debt size and interest rates.



C101697177

This document is a review of the literature on the effects of the Vietnam War on the health of American veterans. It is a review of the literature, not a study. The review is based on a search of the literature in the field of health effects of the Vietnam War. The review is organized into three main sections: (1) a review of the literature on the health effects of the Vietnam War, (2) a review of the literature on the health effects of the Vietnam War on the health of American veterans, and (3) a review of the literature on the health effects of the Vietnam War on the health of American veterans.

Wesley, James V. (1987). Health Effects of the Vietnam War: A Review of the Literature. Washington, D.C.: U.S. Department of Health and Human Services, Office of the Assistant Secretary for Health.

Confidence in the results of studies of the health effects of the Vietnam War is based on the quality of the studies. The review is based on a search of the literature in the field of health effects of the Vietnam War. The review is organized into three main sections: (1) a review of the literature on the health effects of the Vietnam War, (2) a review of the literature on the health effects of the Vietnam War on the health of American veterans, and (3) a review of the literature on the health effects of the Vietnam War on the health of American veterans.

